Growth in Ontario's Demand for Electric Energy

Policy Planning Branch

Ministry of Treasury, Economics and Intergovernmental Affairs

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GROWTH IN ONTARIO'S

DEMAND FOR ELECTRIC ENERGY

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SUMMARY

1. The rate at which Ontario's demand for electric energy is likely to grow in the next twenty years is crucial in determining the need for facilities, the number of sites, resource requirements, capital requirements and coordination with provincial planning policies.

2. In the past twenty years demand growth in Ontario has fallen short of growth in generating capacity with the result that the province is now capable of meeting well over 90 per cent of its own requirements of electric power. This compares with a 78 per cent self sufficiency in 1950.

3. While imports of electric energy are still significant at 12-14 per cent of Ontario's total supply, they are considerably less so at present than in 1950. Most of the imported power comes from other provinces.

4. Exports of electricity have remained relatively small at 6-8 per cent of Ontario's total supply, but the U.S. has replaced other provinces as the major customer during the last twenty years.

5. In future years expansion of Ontario's power system in line with demand growth would keep Ontario's self sufficiency well in excess of 90 per cent.

6. Within Ontario the commercial services sector has increased its consumption of electricity considerably faster than the residential, manufacturing and mining sectors over the past two decades.

7. Data for the period 1960-72 show that growth in Ontario's demand for electricity can be explained in terms of changes in population, income, prices, production and employment. Demographic and economic conditions were extremely favourable to energy consumption, and electric power - expanding in demand at close to 7 per cent per year - shared the bungeoning market with oil and gas at the expense of coal. Demand growth was easily matched by availability and deliverability.

8. In the 1975-95 period demographic and economic conditions, including pricing, will likely be considerably less favourable to the demand for electricity. As compared with the situation in the sixties, slower growth in population and household formation, more moderate expansion in the Ontario economy, rapidly rising energy prices (including those for electricity) in relation to other prices, reversal of the down-trend in durable goods prices relative to other prices would all tend to slow down future electricity demand growth.

9. The reaction of economic agents to possible tightness in energy supply conditions could lead to a slowing down in energy demand growth. The reaction may take the form of conservation, increased efficiency in energy-using equipment and development of alternative energy sources such as solar power. The emergence of these responses would presumably affect consumption of coal, oil and natural gas, as well as electricity. In the 1975-85 period it is conservation and some increased efficiency that will likely have any impact while in the longer term technological advancement could make increased efficiency and alternative energy sources more important in curbing growth in consumption of coal, oil, gas and electric energy. It is extremely difficult to estimate how large the impact of these developments might be over the next twenty years.

10. The major factor that might emerge in the next ten years to boost the demand for electricity in the residential and business sectors is a shift from oil and natural gas if physical fuel shortages are perceived as real. While most of the shifting might occur in new housing (residential and commercial) and new equipment, the process might be somewhat constrained by change-over costs in existing facilities.

11. In the 1975-85 period growth in Ontario's demand for electricity is likely to be about 5.5 per cent per year while in the 1985-95 period, the growth rate might be around 5.0 per cent per year. While expected demographic and economic conditions enter into these projections for the next twenty years, some allowance has been made only in the 1975-85 period for conservation, improved efficiency in electricity-consuming equipment, and a shift from oil and gas to electricity.

I

INTRODUCTION

One of the key questions to be considered in planning expansion of the power system is the expected growth in demand for electric energy. The Porter Commission, in its examination of Ontario Hydro's Long Range Plan, will no doubt find this question central to its deliberations on the need for facilities, the number of sites, resource requirements, capital requirements, and coordination with provincial planning policies.

The crucial importance of demand growth is the prime reason for the present study. It appears that current and future demographic and economic conditions in the province are likely to differ substantially from those of the past, and simple extrapolations of past growth could lead to various planning errors. The present study utilizes an econometric approach to sort out the influences of demography, income, prices and output and to project the demand for electricity under alternative combinations of these influences. The approach also permits sensitivity tests of the effects of unpredictable but hypothetical shifts in the availability of competing fuels (oil and gas essentially). Projections are finally developed to take account of possible future contingencies.

II

ONTARIO'S ELECTRICITY SUPPLY-DISPOSAL SITUATION

Over the past twenty years or so Ontario has improved its capacity to meet provincial electricity requirements. Whereas, in 1950, the amount generated in the province fell short of disposal within the province by more than 20 per cent, the gap was narrowed considerably in the 1960's and, in the early 1970's, the shortfall was well under 10 per cent. This is shown in Table 1.

SUPPLY AND DISPOSAL OF ELECTRIC ENERGY
ONTARIO, 1950-1974 (Billions of KWH) — Table 1

	1950	1960	1965	1970	1972	1974
Supply of Energy	19.8	42.1	52.6	73.3	85.3	96.7
Generated in Ontario	14.6	35.8	44.8	63.9	75.0	82.4
Imported from other Provinces	5.2	6.0	4.9	6.5	8.6	12.5
Imported from the U.S.	-	0.3	2.9	2.9	1.7	1.8
Disposal of Energy	19.8	42.1	52.6	73.3	85.3	96.7
Within Ontario	18.7	37.2	49.2	69.5	79.1	88.6
Exported to other Provinces	1.1	0.2	0.3	0.2	0.2	0.2
Exported to the U.S.	-	4.7	3.1	3.6	6.0	7.9
Amount Generated in Ontario as a Percentage of Disposal within Ontario	78.1	96.2	91.1	91.9	94.8	93.0

Source: Statistics Canada

With provincial generating capacity growing faster than total supply, the contribution of outside sources, in particular other p rovinces, has been reduced. Imports in the early 1970's accounted for 12 to 15 per cent of total supply as compared with 26 per cent in 1950.

Significant changes have also occurred in the exportation of electrical energy from Ontario. Exports in 1950 amounted to about 6 per cent of total supply and went almost entirely to other provinces. In the early 1970's, exports bore approximately the same relation to total supply, but flowed almost entirely to the U.S.

It is thus evident that generation of electricity in Ontario has outpaced provincial requirements in growth, and the effect has shown up in relative terms as import substitution rather than export improvement. In the years ahead, self-sufficiency in excess of 90 per cent can be protected adequately by ensuring that the growth in provincial generation is in line with the growth in provincial requirements.

Table 2 shows provincial requirements in various sectors of the economy. Four broad sectors -- residential,[1] manufacturing, mining and commercial[2] -- are identifiable in the Statistics Canada data, and these accounted for about 91 per cent of the total provincial disposal in recent years[3], as compared with about 88 per cent in 1950. The balance represents losses, amounts unaccounted for, own use in utilities, and statistical estimation errors, and this has tended to decline marginally over the past two decades.

SECTORAL DISPOSAL OF ELECTRIC ENERGY, ONTARIO, 1950-1972 (Billions of KWH) — Table 2

	1950	1960	1965	1970	1972
1) Residential Sector*	3.7	9.3	12.7	17.6	19.6
2) Manufacturing Sector	9.5	15.6	20.0	25.5	27.0
3) Mining Sector	0.9	2.3	2.0	3.3	3.4
4) Commercial Services	2.4	5.7	9.9	17.0	22.0
5) Losses, Own Use in Utilities and Residual Error	2.2	4.3	4.6	5.1	7.1
6) Total Disposal within Ontario	18.7	37.2	49.2	69.5	79.1
7) Total Provincial Consumption in Sectors 1-4					
- in billion KWH	16.5	32.9	44.6	63.4	72.0
- as a percentage of Disposal in Ontario	88.2	88.4	90.7	91.2	91.0

Source: Statistics Canada, Electric Power Statistics, Vol. II.

* Domestic and Farm Use.

1. "Residential" covers domestic and farm use.
2. "Commercial" includes street lighting.
3. The last year for which such sectoral data are available was 1972.

Total provincial consumption in the residential, manufacturing, mining and commercial sectors rose from 16.5 billion KWH in 1950 to 72.0 billion KWH in 1972, an increase of 336 per cent. By far the strongest growth in consumption occurred in the commercial sector, which registered an increase of 817 per cent in this period. This compares with 430 per cent in the residential sector, 278 per cent in mining, and 184 per cent in manufacturing. The recent pattern of electricity use indicates that manufacturing accounts for about 37 per cent of provincial consumption (excluding losses and own use), the commercial sector 31 per cent, the residential sector 27 per cent, and mining the balance of 5 per cent.

The total Ontario market has been served by Ontario Hydro, privately-operated utilities, and industrial establishments having their own facilities. For the purpose of gauging future growth in the provincial market one could project the demands placed on each supplier or, alternatively, project the demands arising from various groups of customers. The latter approach is adopted in this study so as to determine how consumers might respond to changes in demand conditions. The analysis thus focuses on the overall Ontario market as represented by four broad consuming sectors -- residential, manufacturing, mining and commercial services sectors -- exclusive of losses, own use in utilities and estimating errors.

III

DETERMINANTS OF THE DEMAND FOR ELECTRIC ENERGY IN ONTARIO

The purpose of this section is to specify the major determinants of the demand for electric energy. Economic theory suggests that, under very general conditions, demand in the residential sector -- which reflects the behaviour of households -- would be influenced by population changes, variation in the income and wealth position of households, changes in the price of electricity relative to prices of competing forms of fuel and other consumer goods, and changes in the price of complements (electrical durables, in particular). Theory also suggests that, in the business sector, enterprises would vary their consumption of electricity in response to changes in the level of production, changes in the price of electricity relative to prices of competing energy forms used in production processes and relative to the prices of products embodying energy inputs.

A broad survey of demographic and economic conditions from 1960 to the mid-1970's introduces the electricity demand environment followed by the estimated functional relationships between the demand for electricity in the residential, manufacturing, mining and commercial sectors and such underlying conditions. Estimates of electricity consumption in the 1973-75 period are then derived from these relationships.

1. Survey of Demographic and Economic Conditions From 1960 to the Early 1970's

During the 1960's, Ontario's population base expanded at an annual average rate of about 2.2 per cent. While this represented a slowing down from the 3.1 per cent of the earlier decade, it was quite high by historical standards. The addition of some 1.5 million to the population in the 1960's was attributable both to strong natural increase and significant net in-migration of about

60,000 per year. The early 1970's witnessed further slowing down in the rate of population increase under conditions of a declining fertility rate and reduced net in-migration.

The Ontario economy expanded rapidly in the favourable conditions of the 1960's. Growth in provincial and national population levels generated strong domestic demand for goods and services and permitted adequate elasticity in the supply of labour. The external value of the Canadian dollar was pegged at a substantial discount and provided a strong boost to exports, particularly of Ontario's manufactured goods. The Auto Pact came into effect giving a massive boost to investment, employment, exports, and income in Ontario.

Buoyant conditions were reflected in almost every aspect of economic activity. The real gross provincial product expanded at an average annual rate of 6.4 per cent. Real consumer spending gained at a rate of 5.6 per cent per year in response to strong growth in disposable incomes and in the housing stock. The markets for major household durables -- cooking appliances, refrigerators, freezers, clothes washers and dryers, hot water heaters, air conditioners, etc. -- all benefited from the increases in population and purchasing power. Production and employment gained substantially in the manufacturing and service sectors and to a lesser extent in mining. Inflation was never really a major issue in the 1960's, though towards the end of the decade price increases in excess of 4 per cent were being considered unacceptable.

In the energy area, the supply of various sources was expanding far more rapidly than the overall demand. Major distribution systems had been put in place for bringing oil and natural gas to Ontario's burgeoning markets, and severe price competition not only prevented dramatic shifts in the relative prices of competing fuels but also brought about a decline in energy prices relative to the general level of prices in the economy. In addition, the prices of household durables tended to decline in relation to the aggregate price level for goods and services.

In general, then, demographic and economic conditions of the 1960's were extremely favourable to rapid growth in the demand for all forms of energy and, despite the penetration attained by natural gas and oil, Ontario's demand for electricity grew at a rate of close to 7 per cent per year. It was coal that suffered in strong competition for a larger share of the energy market.

By the mid 1970's, many of these favourable conditions were changing. A recession in 1970 has been followed by a much longer and more severe recession in 1974-75. Inflation has hit both the international and domestic economies. Energy prices have escalated rapidly and significant shifts are occurring in the regional balance of economic power. And the population base of Ontario is expanding at a much slower rate than in the last decade.

2. The Relationship Between Electricity Demand and Demographic and Economic Conditions

Using annual data for the period 1960 to 1972, econometric methods were employed to obtain quantitative relationships between the demand for electricity in various sectors of the Ontario economy and indicators of demographic and economic conditions. For each of the four sectors -- residential, manufacturing, mining and commercial services -- a number of alternative specifications were tried. The best specification for each sector was determined by applying standard statistical criteria of "goodness of fit", criteria from economic theory in terms of signs of coefficients, and some judgment about the magnitude of coefficients. It should be noted that, because of the relatively small number of observations and hence degrees of freedom, less weight than is normally assigned to "impersonal" statistical criteria has been employed in this exercise.

A. Demand in Ontario's Residential Sector

Growth in the demand for electricity in Ontario's residential sector in the 1960-72 period can be explained in terms of growth in stock of housing units and household appliances as well as changes in prices. Expansion in housing stock invariably increases the demand for electric energy. This is so because of lighting requirements for which there are virtually no substitutes and also because of the associated demand for appliances and heat. In the case of certain appliances, electricity has no substitutes, for example refrigerators, vacuum cleaners and home entertainment sets. In other cases, however, such as cooking appliances, clothes dryers, hot water heaters and heating devices, substitutes do exist (mainly oil and gas).

Over long periods of time, population and income tend to be the main determinants of growth in the housing stock and in the stock of appliances, so that the demand for electricity could be expressed in terms of population and income. Given some room for substitution between electricity and other energy forms, however, one would expect this demand to be modified by changes in the price of electricity relative to that of competing fuels, and changes in the price of electrical durables relative to that of other goods. Such price changes would tend to affect the rate of utilization of existing stocks of appliances and to modify, to some extent, the rate of accumulation of such stocks.

Translating these considerations into a mathematical relationship always involves simplification, imprecision and rigidity. Nevertheless, such a relationship might have the merits of capturing the most fundamental elements operating in a given situation and of providing useful approximate answers to "what if" questions.

The 1960-72 data on electricity consumed, population, income and prices suggest the following statistical relationship:[1]

$$\log_e QED = 0.7096 + 0.7415 \log_e(POP*YDP) - 0.1118 \log_e SD - 0.8367 \log_e CD$$

Where: $\log_e$ is the natural logarithm;
QED is the quantity of electricity consumed annually in the residential sector, in billions of KWH;
POP is the size of the population, in millions;
YDP is the real disposable income per capita, in thousands of dollars per year;
SD is the ratio of the price of 1,000 KWH monthly residential consumption of electricity to the price of 1,000 cubic feet of residential consumption of natural gas;
CD is the ratio of the price index of appliances in the Consumer Price Index to the overall CPI;
* means 'multiplied by'.

This relationship indicates that a 10 per cent increase in either population or real disposable incomes would increase the consumption of electricity in Ontario's residential sector by 7.4 per cent. However, increases in relative prices would lead to varying degrees of decline in consumption.

During the decade of the 1960's, Ontario's population grew at an average annual rate of 2.2 per cent, real disposable income per capita gained about 2.6 per cent annually, and the ratio of the price of electrical durables to the Consumer Price Index declined almost 3.5 per cent per year. These were positive contributions to growth in the residential sector's demand for electricity. They were offset only marginally by a 2 per cent average annual rise in electricity prices relative to natural gas prices. According to the estimated relationship above, the sector's demand for electricity should have registered a 6.3 per cent average growth rate. This estimate compares very favourably with the actual growth of 6.5 per cent.

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1. See Statistical Appendix for results of the regression analysis.

B. Demand in Ontario's Manufacturing, Mining and Commercial Sectors

Electric energy is essentially an input in production rather than a final form of output. As such, under given technological conditions, the consumption of electricity in the producing sectors -- manufacturing, mining and commercial services -- would be related to the level of production, competing input prices, and output prices. In many cases, electricity is a complement to other inputs, and there might be very little room for substitution, as in the case of lighting. In the area of motive power, equipment using electricity is substitutable for human resources, and production processes may vary the combinations of manpower and equipment in the long run. Similarly, substitution between electricity and fuels such as coal, oil and gas, is possible in providing motive power. While adequate data are unavailable to determine such specific substitution effects, it is almost certainly true that general substitution exists between electricity and energy fuels in providing motive power, process heating and space heating. Some of this substitution effect could arise from relative price changes. Some might also arise from technological changes and from environmental requirements.

Subject to the same kind of comments on simplification and imprecision indicated above for the relationship in the residential sector, the 1960-72 data on electricity consumed, employment, production, and prices suggest that statistical relationships in the producing sectors do exist.

In the manufacturing sector, the estimated equation for electricity consumption is:[1]

$$\log_e QEMF = 2.1868 + 0.4578 \log_e OMF + 0.3859 \log_e QEMF_{-1} - 0.2071 \log_e PIQ$$

Where: $\log_e$ is the natural logarithm;
QEMF is the quantity of electricity consumed annually in the manufacturing sector, in billions of KWH;
OMF is the real value of annual output produced in manufacturing, in $ billion;
QEMF-1 is the value of QEMF in the previous year;
PIQ is the ratio of the price of 30,000 KWH monthly consumption of electricity to the implicit price index for deflating gross national expenditure.

In the mining sector, the estimated equation for electricity consumed is:[1]

$$\log_e QEM = 5.7019 + 0.4032 \log_e OM + 0.5002 \log_e QEM_{-1} - 0.1579 \log_e SCG - 0.9485 \log_e CIQ$$

Where: $\log_e$ is the natural logarithm;
QEM is the quantity of electricity consumed annually in the mining sector, in billions of KWH;
OM is the real value of annual output in mining, in $ billion;
QEM_{-1} is the value of QEM in the previous year
SCG is the ratio of the price of 15,000 KWH monthly consumption of electricity to the monthly price per 100 mcf of natural gas for commercial use;
CIQ is the ratio of the price of 15,000 KWH monthly consumption of electricity to the implicit price deflator for gross national expenditure.

In the commercial services sector, the estimated equation for electricity consumed is:[1]

$$\log_e QECE = 0.5452 + 2.7519 \log_e OCE - 0.7995 \log_e CIQ$$

Where: $\log_e$ is the natural logarithm;
QECE is the quantity of electricity consumed per employee annually in the commercial sector, in thousands of KWH;
OCE is the annual real output per employee in the commercial sector, in $ thousand;
CIQ is the price ratio defined above for the mining sector relationship.

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1. See Statistical Appendix for results of the regression analysis.

These equations provide strong support for the hypothesis that electricity consumption varies directly with production in the three sectors. In manufacturing, a 10 per cent increase in output raises electricity consumption by about 4.6 per cent in the short run, and by about 7.4 per cent after adjustments are made to production processes in the long run. In mining, a similar increase in output would require additional electricity of 4 per cent in the short run and 8 per cent after adjustments. With respect to the commercial services sector, large increases in electricity demand are associated with improvements in worker productivity: a 10 per cent increase in output per employee is accompanied by some 27 per cent increase in electricity used per worker.

The data upon which the equations are based do not show the extent of substitution between energy forms in response to relative price changes in the manufacturing and commercial sectors. While there have been changes in the price of electricity relative to oil and gas prices, it has not been possible to identify any substitution that might have resulted in these sectors during the sample period. In the case of mining, there is some evidence that increases in the price of electricity relative to that of natural gas lead to reduction in electricity consumption.

It is a well-known general proposition in economic theory that producing enterprises guided by profit maximization would tend to reduce their demand for an input whose price rises in relation to output prices. The estimated equations for all three sectors provide support for this hypothesis. Increases in the price of electricity relative to the general level of prices (the implicit deflator for gross national expenditure) induce varying degrees of reduction in electricity consumed in the producing sectors: the effect is greatest (percentage-wise) in the mining sector and smallest in the manufacturing sector.

During the sixties, employment in Ontario's manufacturing sector grew at an average annual rate of about 2.8 per cent, and in the commercial services sector, the annual gain was some 3.1 per cent. In mining, employment registered an average decline of about 1 per cent per year. Output growth was quite strong in all three sectors, with 7 per cent per year in manufacturing, 2.4 per cent in mining and 5.7 per cent in the commercial services sector. These production increases, combined with a decline in the ratio of electricity prices to the general price index amounting to about 3.1 per cent per year, provided strong stimulus to the demand for electricity. According to the estimated sectoral equations, the conditions of the 1960's should have produced an average annual growth in the demand for electricity of 5.3 per cent in manufacturing, 3 per cent in mining and 11 per cent in the commercial sector. These compare with actual growth rates of 5.1 per cent, 3.8 per cent and 11.5 per cent in the respective sectors. While the estimation error is relatively large in the case of mining, it should be remembered that this sector now accounts for some 5 per cent of the provincial total.

C. Estimates of Electricity Consumption, 1973-75

Using the above estimated equations for electricity demand in Ontario's sectors, and estimates of right-hand side variables where necessary, calculations of consumption were made for the years 1973, 1974 and 1975.[1] These are shown in Table 3 along with consumption in 1972, the last year for which actual figures are available.

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1. When these equations are used for projecting outside the sample period, the disturbance terms are set equal to their expected values of zero. Because of the logarithmic specification assumptions employed for estimating the equations, a positive adjustment to the constant term in each equation then becomes necessary.

CONSUMPTION OF ELECTRICITY IN ONTARIO, 1972-1975 (Billions of KWH)

Table 3

Sector	Actual	Estimated			Estimated Percentage Change		
	1972	1973	1974	1975*	73/72	74/73	75/74
1. Residential**	19.61	20.82	22.22	23.11	6.2	6.7	4.0
2. Manufacturing	26.96	28.29	28.99	29.67	4.9	2.5	2.3
3. Mining	3.37	3.68	4.06	4.13	9.2	10.3	1.7
4. Commercial Services	22.03	24.40	26.52	27.49	10.8	8.7	3.7
PROVINCIAL TOTAL (1-4)***	71.97	77.19	81.79	84.40	7.3	6.0	3.2

Source: Statistics Canada data for 1972, and Ministry of Treasury, Economics and Intergovernmental Affairs estimates for the other years.

* Control projection.
** Domestic and farm use.
*** This represents the total provincial consumption in the four sectors and is equivalent to Total Disposal within Ontario less allowance for losses, own use in utilities, etc.

The estimates show a strong decline in demand growth in all sectors by 1975. This is attributable to the prevailing recessionary conditions despite any stimulus that might have been given to electricity demand by the sharp price increases for oil and natural gas. Provincial consumption in the four sectors is likely to reach 84.4 billion KWH in 1975, an increase of some 3.2 per cent from the 1974 level.

Total disposal of electric energy within Ontario consists of the amounts consumed in the four sectors plus an allowance for losses, own use in utilities and residual errors. Actual data on total disposal reveal growth of 5.9 per cent in 1973, 5.8 per cent in 1974 and 2.9 per cent in the first half of 1975 from the first half of 1974. Hence, there seems to be a fair correspondence between the actual growth in total disposal and the estimated growth in total consumption of the four sectors.

IV

PROJECTIONS OF ELECTRIC ENERGY DEMAND IN ONTARIO, 1975-1995

This section presents alternative projections of growth in Ontario's demand for electric energy to 1995. It is recognized that numerous uncertainties exist in projecting future developments that might affect the growth in demand. These uncertainties include demographic and economic conditions, availability of alternative energy sources, life styles and technology.

The approach used in making the projections involves essentially two stages. First, the quantitative relationships derived from 1960-72 data are employed to estimate demand growth under different scenarios for demographic and economic conditions, including pricing. Second, adjustments are made to the first stage projections to allow for contingencies, including possible effects of hypothetical shortages of oil and natural gas. These adjustments reflect uncertainties in a period that might be quite different from the one used to estimate earlier demand growth.

1. First Stage Projections - Based on Probable Demographic and Economic Conditions

The first stage considers five scenarios for population, economic growth and energy prices.

Scenario A, used in developing a control projection, represents a likely set of outcomes for population, economic growth and prices over the next two decades, and it is based on other studies done by the Ministry of Treasury, Economics and Intergovernmental Affairs.[1] According to this scenario, the situation in Ontario might be as follows:

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1. See the following studies prepared by the Policy Planning Branch, Ministry of Treasury, Economics and Intergovernmental Affairs, 1976:
   a) "Long Term Outlook for Labour Force Growth: Canada and Ontario".
   b) "Long Term Economic Outlook for Ontario".
   c) "A Long Term Projection of Ontario's Industrial Development Pattern".

- Growth in population would decline steadily from about 1.6 per cent per year in the 1975-80 period to 1.1 per cent per year in the 1990-95 period. This results from a declining fertility rate together with an annual net in-migration of 50,000 per year. As compared with the 1960's, population growth would be considerably slower in the next twenty years.

- Growth in the working age population would also follow a declining trend and, despite increases in participation rates, growth in the labour force would slow down from about 2.8 per cent per year in the 1975-80 period to 1.6 per cent annually after 1985.

- There could be some minor decline in the average family size but, because of the population slow down, the number of households could grow far more slowly in the next decade than in the 1960's. This provides a basis for declining growth in the stock of household durables.

- Constraints arising from the supply of labour would produce a dampening effect on overall employment growth.

- Growth in overall provincial product could follow a declining trend as labour constraints emerge and as foreign, national and provincial demands moderate from the very favourable circumstances of the 1960's, and as the drive for economic development in western Canada gains momentum from energy-related developments. The real GPP growth rate for Ontario is likely to decline from about 5.2 per cent per year in the 1975-80 period to about 4 per cent per year in the early 1990's. This compares with an average of 6.4 per cent for the 1960's.

- Inflation could continue at rates of between 7 and 10 per cent for at least the next five years, and is unlikely to fall below 5 per cent in the 1980's, because of persisting wage and resource price pressures.

- Despite such inflation, real disposable income per person could grow at about 3 per cent per year into the 1980's. However, energy prices, rising considerably faster than the general level of prices, and prices of durable goods, rising more in line with the general level at least until 1985, could lead to a restructuring of consumer purchases. These price developments represent a reversal of the situation in the 1960's and, together with some decline in growth in the number of households, they could produce some offset to growth in household durable demand arising from income growth.

- It is assumed that the ratio of electricity prices to the general price index would rise steadily to 1985 and flatten out thereafter; by 1985, the cumulative rise in the ratio from 1975 is assumed to be between 45 and 50 per cent. However, the ratio of electricity prices to prices of natural gas is assumed to drop in the 1975-80 period, and to be constant beyond that.

- While the next ten years are described in terms of sharply rising energy prices, it is assumed that physical shortages of oil and gas will not emerge in Ontario.

- Output and employment in manufacturing, mining and commercial services will continue to grow over the next two decades, but at steadily declining rates, or at rates below those recorded in the 1960's. The service sector will continue to increase its share of provincial product and employment.

Scenario B differs from Scenario A (the control projection) only in respect of the assumption of electricity prices. Here, the ratio of electricity prices to the general index rises somewhat more slowly to 1985, and then declines over the subsequent ten years. Also, the ratio of electricity prices to natural gas prices declines somewhat more rapidly throughout the next two decades. In general, then, Scenario B postulates cheaper electricity than Scenario A.

Scenario C differs from Scenario A in the assumptions about population, income and employment. Here, faster growth in population and economic growth is assumed over the next two decades.

Scenario D utilizes a slower growth in population and economic growth as compared with Scenario A.

Scenario E assumes that population growth, economic growth and price increases for electricity are all higher than those assumed in Scenario A.

None of these scenarios for Ontario is as favourable to electricity consumption as the conditions of the 1960's. Growth in population and the overall economy was significantly faster in the 1960's than in each of these scenarios, and electricity and energy prices in general, which tended downward relative to other prices in the 1960's, are assumed to follow an up-trend in each scenario. Like the situation of the sixties, however, no physical energy shortages are assumed in any scenario.

Table 4 shows the estimated growth in Ontario's electricity consumption according to the control projection. If the conditions of Scenario A emerge in future -- conditions which are perhaps quite likely -- growth in consumption beyond 1975 could be substantially lower than those recorded in the past fifteen years. Growth in the 1975-85 period might be severely reduced in all sectors by the economic and pricing environment, and by the slowing down in population growth. Beyond 1985, even if electricity prices stabilize in relation to other prices, the effect of continued decline in population and

economic growth would be to keep growth in electricity consumption well below that of the 1960's.

GROWTH IN ELECTRICITY CONSUMPTION, ONTARIO, 1960-1995 (CONTROL PROJECTION) — Table 4

Sector	Average Annual Growth Rate (Per Cent) Actual		Estimated				
	60-65	65-70	70-75	75-80	80-85	85-90	90-95
1. Residential*	6.3	6.8	5.6	4.0	3.3	3.2	3.0
2. Manufacturing	5.1	5.0	3.0	2.2	2.2	2.7	2.8
3. Mining	-2.6	10.2	4.8	-4.4	-3.7	1.3	2.4
4. Commercial Services	11.5	11.5	10.0	3.6	5.7	7.8	7.7
PROVINCIAL TOTAL**	6.2	7.3	5.9	2.9	3.6	4.8	5.1

Source: Statistics Canada, actual data to 1972.
Estimates for subsequent years by Ministry of Treasury, Economics and Intergovernmental Affairs.

* Domestic and farm use.
** This represents total provincial consumption obtained from aggregating the four sectors shown. It is equivalent to total disposal within Ontario less allowance for losses, own use in utilities, etc.

Table 5 shows the distribution of sectoral consumption obtained from the control projection as well as the actual for 1972. What stands out is the long run tendency for the commercial sector to consume an increasing share of provincial consumption; by 1995 just under half of the total would be consumed by this sector. This reflects the underlying growth in production and employment in services relative to goods-producing sectors such as mining and manufacturing. In the long run too, the decline in population growth is reflected in a drop in the residential sector's share.

It thus appears that a base from which to consider alternative projections for growth in Ontario's electricity consumption would be one in which provincial demand is growing at an annual rate of about 3 per cent in the 1975-80 period, just over 3.5 per cent in the 1980-85 period, and approximately 5 per cent in the subsequent ten years. Starting from an estimated 84.4 billion KWH in 1975, consumption could reach 116 billion KWH in 1985 and 188 billion KWH in 1995.

SECTORAL DISTRIBUTION OF ELECTRICITY CONSUMPTION, ONTARIO, 1972-1995 (CONTROL PROJECTION)

Table 5

Sector	Consumption in Billions of KWH				Per Cent of Provincial Consumption			
	Actual	Projected			Actual	Projected		
	1972	1975	1985	1995	1972	1975	1985	1995
Residential	19.6	23.1	33.1	44.9	27.2	27.4	28.5	23.9
Manufacturing	27.0	29.7	36.9	48.5	37.5	35.2	31.8	25.8
Mining	3.4	4.1	2.7	3.3	4.7	4.8	2.3	1.7
Commercial Services	22.0	27.5	43.3	91.4	30.6	32.6	37.3	48.6
PROVINCIAL TOTAL*	72.0	84.4	116.0	188.1	100.0	100.0	100.0	100.0

Source: Statistics Canada for 1972 actual figures.
Estimates for subsequent years by Ministry of Treasury, Economics and Intergovernmental Affairs.

*Sum of the four sectors shown.

Table 6 summarizes the projections for growth in Ontario's electricity demand under Scenarios A to E.[1] Chart I portrays the results for the provincial aggregate under these scenarios, that is, before contingency allowances. In comparison with the control projection of Scenario A:

- Scenarios B and C would result in a more rapid growth in consumption; and
- Scenarios D and E would yield less rapid growth in consumption.

For any given five-year period in the 1975-1985 period, the growth rates of Scenarios B to E for total Ontario consumption do not differ from those of the control projection by more than 1.1 percentage points; beyond 1985, the difference from the control projection is at most 1.5 percentage points. In other words, under a fairly wide variety of future potential population, economic growth and pricing assumptions, the control projection provides a reasonably good approximation of expected growth in Ontario's electricity consumption.

Table 7 shows the levels of provincial consumption associated with the control projection and the alternative scenarios in 1985 and 1995. The outstanding feature is that the variety of circumstances considered for the future produces consumption levels which are within 12 per cent of the control projection in 1985, and within 27 per cent of the control projection in 1995. If one assigns any reasonable probability to the emergence of this range of circumstances, the control projection could serve as a convenient basis for making judgments about likely levels of future electricity consumption in Ontario.

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1. These growth rates are computed from the projected demand levels shown in Table A1, Statistical Appendix.

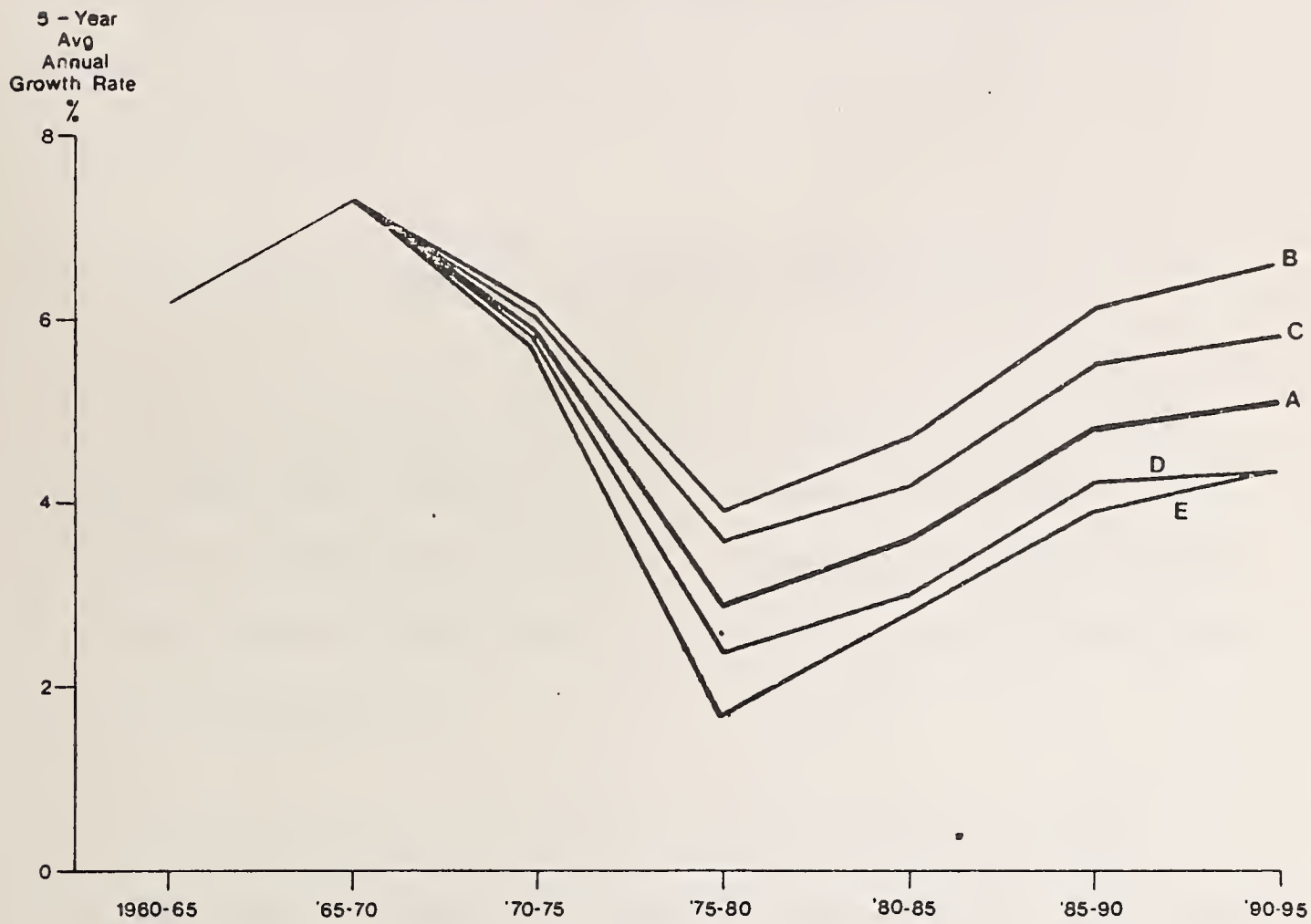
GROWTH IN ELECTRICITY CONSUMPTION, ONTARIO, 1960-1995
Alternative Scenarios (Percentage Annual Average Rates of Growth)

Table 6

	Actual**		Projected				
	1960-65	1965-70	1970-75**	1975-80	1980-85	1985-90	1990-95
A. Control							
Residential	6.3	6.8	5.6	4.0	3.3	3.2	3.0
Manufacturing	5.1	5.0	3.0	2.2	2.2	2.7	2.8
Mining	-2.6	10.2	4.8	-4.4	-3.7	1.3	2.4
Commercial Services	11.5	11.5	10.0	3.6	5.7	7.8	7.7
PROVINCIAL TOTAL*	6.2	7.3	5.9	2.9	3.6	4.8	5.1
B. Control + Lower Electricity Prices							
Residential	6.3	6.8	5.7	4.4	3.7	3.5	3.4
Manufacturing	5.1	5.0	3.1	2.9	2.8	3.4	3.5
Mining	-2.6	10.2	5.3	-0.3	0.9	6.2	7.4
Commercial Services	11.5	11.5	10.4	5.2	7.3	9.5	9.5
PROVINCIAL TOTAL *	6.2	7.3	6.1	3.9	4.7	6.1	6.6
C. Control + Higher Population, Employment and Income							
Residential	6.3	6.8	5.7	4.5	3.8	3.7	3.5
Manufacturing	5.1	5.0	3.1	2.7	2.7	3.3	3.3
Mining	-2.6	10.2	4.9	-3.9	-3.1	1.8	2.9
Commercial Services	11.5	11.5	10.3	4.7	6.5	8.5	8.6
PROVINCIAL TOTAL *	6.2	7.3	6.0	3.6	4.2	5.5	5.8
D. Control + Lower Population, Employment and Income							
Residential	6.3	6.8	5.5	3.5	2.9	2.7	2.7
Manufacturing	5.1	5.0	3.0	1.9	1.8	2.4	2.4
Mining	-2.6	10.2	4.8	-4.8	-4.0	0.9	2.0
Commercial Services	11.5	11.5	9.8	2.8	4.9	7.0	6.7
PROVINCIAL TOTAL *	6.2	7.3	5.8	2.4	3.0	4.2	4.3
E. Control + Higher Population, Employment, Income and Electricity Prices							
Residential	6.3	6.8	5.3	2.4	1.9	1.8	1.6
Manufacturing	5.1	5.0	3.0	1.8	2.0	2.6	2.6
Mining	-2.6	10.2	4.2	-9.3	-7.5	-2.5	-1.5
Commercial Services	11.5	11.5	10.0	3.6	5.7	7.8	7.7
PROVINCIAL TOTAL*	6.2	7.3	5.7	1.7	2.8	3.9	4.3

*Total of four sectors shown. **Actual data used up to 1972. SOURCE: Statistics Canada.

GROWTH IN ONTARIO'S CONSUMPTION OF ELECTRICITY
(Alternative Projections without Contingency Allowances) CHART I



LEGEND: A - Control Projection (based on Probable Demographic, Economic and Pricing Conditions).
B - Control plus Lower Electricity Prices.
C - Control plus Higher Population, Employment and Income.
D - Control plus Lower Population, Employment and Income.
E - Control plus Higher Population, Employment, Income and Electricity Prices.

Source: Based on Table 6.

PROJECTED CONSUMPTION OF ELECTRICITY IN ONTARIO UNDER ALTERNATIVE SCENARIOS, 1985 AND 1995 Table 7

	Billions of KWH		Percentage of Control Projection	
	1985	1995	1985	1995
Provincial Consumption* in:				
A. Control Projection	116.0	188.1	100	100
B. Lower Electricity Prices	129.6	239.7	112	127
C. Higher Population, Employment, Income	124.5	215.8	107	115
D. Lower Population, Employment, Income	109.5	166.1	94	88
E. Higher Population, Employment, Income and Electricity Prices	104.3	155.8	90	83

*Total consumption in the Residential, Manufacturing, Mining and Commercial Sectors.

None of the scenarios -- except perhaps B in the 1985-95 period -- produces growth in demand approximating those of the 1960's. Based on probable demographic, economic and pricing conditions, therefore, there seems to be doubt that growth in electric energy demand in future would be sustained at the pace recorded over the last fifteen years.

2. Second Stage Projections - Allowing for Contingencies

The second stage in developing the projections of electric energy demand takes account of possible tightness in energy availability conditions in the 1980's. Recently, increasing concern has been expressed about Canada's ability to retain self-sufficiency in oil and natural gas.

If the public perceives a real threat of fuel shortages, adjustments in life styles and technology would probably occur faster than normal. There might be an induced shift to electrical power in both the residential and business sectors of the economy, greater conservation[1] of energy as a matter of private practice or public policy, more rapid improvement in the efficiency of energy-using equipment and more urgent development of alternative sources of energy.

Some of these changes could have a relatively strong impact in the 1975-85 period while others, notably the development of new energy sources like solar power, might not have an effect until much later. The greatest impact over the next ten years on electric energy demand might result from a shift by households and businesses.

---

1. Popular use of the word "conservation" carries the meaning of 'reduced consumption' regardless of whether the effect arises from changes in price, income, production, technology, attitudes and habits, or any other possible circumstance. In the present study, "conservation" is used in the rather restricted sense of reduced consumption due to changes in attitudes, tastes, habits and ethics, given any configuration of other measurable parameters.

While the threat of shortages can be expected to lead to 'forced substitution' of electricity throughout the economy, it is extremely difficult to estimate the magnitude in different sectors. In what follows, an attempt is made to estimate the effect in the residential sector only and, although the assumptions are somewhat tenuous, they are probably less tenuous than those that might be made about the producing sectors -- manufacturing, mining and commercial services.

Assuming, then, that households perceive the threat of oil and gas shortages as being real in the 1980's and do attempt to shift to electricity during the next ten years, the question is: how large might the shift be? Some insight may be gained by examining substitution possibilities.

In the area of household durables and equipment, substitution is not possible in the case of refrigerators, freezers, automatic clothes washers, air conditioners and home entertainment sets. Shifts are, however, possible in clothes dryers, cooking appliances, hot water heaters and heating equipment. In the area of transportation there is a possibility of shifting from use of own cars to, say, public transportation using electric power, in which case the increased demand for electricity would be revealed in the commercial services sector rather than in the residential sector.

In 1974, the stock of clothes dryers in Ontario's residential sector was some 1.15 million units, of which close to 90 per cent used electricity. The total stock could reach a level of 1.96 million in 1980 rising to 2.89 million in 1985, given an increase in the saturation factor and in the number of households. If no shortage of gas is perceived, electric dryers could remain close to the 90 per cent level which has prevailed in the last fifteen years. If a shortage is perceived, electric dryers could amount to almost 93 per cent of the stock in 1980 and 97 per cent in 1985.

Stocks of cooking appliances, hot water heaters and heating equipment have already reached saturation levels in Ontario, and future growth will therefore be constrained by household formation. Despite competition in the past, electric cooking appliances and heating equipment have grown faster than the market: the former rose from 77 per cent of the total stock in 1961 to 86.7 per cent in 1974, while the latter increased from about 1 per cent to 8.6 per cent in the same period with the most rapid gains occurring in the last five years. It is assumed that, in the absence of oil and gas shortages, such trends would continue and in 1985 electric cooking appliances would reach 91 per cent and electric heating equipment 24 per cent of the respective stocks. It is further assumed that the effect of shortages would be to increase these shares to 93 per cent and 33 per cent respectively in 1985.

It is in the market for hot water heaters that electricity has lost ground in the last fifteen years, the share dropping from 71 per cent in 1961 to 55 per cent in 1974. This tendency, however, has diminished in the last few years. It is assumed that in this highly competitive market, the effect of oil and gas shortages would be to raise electricity's share by 30 percentage points in 1985.

These assumed shifts to electricity are likely to take place mainly in the new housing units to be constructed over the next ten years. Some allowance has been made for conversion of existing stocks, but the huge costs of change-over could limit the extent to which this is done. It may well be that less shifting than is assumed is in fact feasible. However, it is not difficult for one to employ alternative assumptions and re-work the exercise.

Table 8 shows the implications of these assumptions in terms of the additional stock of electrical appliances and electricity demanded. Electricity requirements were computed from the additional

EFFECT OF ASSUMED SHORTAGE OF OIL AND GAS ON ELECTRICITY DEMAND IN THE RESIDENTIAL SECTOR, ONTARIO, 1980 AND 1985

Table 8

	Additional Stock of Electrical Appliances ('000)		Additional Electricity Required (Billions of KWH)	
	1980	1985	1980	1985
Cooking Appliances	59	76	0.07	0.09
Dryers	55	211	0.05	0.19
Hot Water Heaters	503	973	2.01	3.89
Heating Appliances	148	295	2.96	5.89
Addition to Electricity Requirements:				
. in Billions of KWH			5.09	10.06
. as a Per Cent of Residential Total*			18.1	30.4
. as a Per Cent of Provincial Total*			5.2	8.7

Source: Estimates by the Ministry of Treasury, Economics and Intergovernmental Affairs.

* From control projection.

stock and the average annual consumption per appliance. The results show that the residential sector would require an extra 5.1 billion KWH in 1980 and 10.1 billion KWH in 1985 if households felt threatened with physical shortages of oil and gas.

This 'forced substitution' into electric energy by households would raise the control projection for the residential sector from 28.1 billion KWH to 33.2 billion KWH in 1980 and from 44.9 billion KWH to 55.0 billion KWH in 1985. These increases amount to 18 per cent in 1980 and 30 per cent in 1985.

Taking account of 'forced substitution' in the residential sector only, the average annual growth in provincial consumption of electricity (using the control projection) would be raised from about 3 per cent to 4 per cent in the 1975-80 period, and from 3.6 per cent to 4.2 per cent in the 1980-85 period. Under these circumstances, provincial consumption would reach 102.5 billion KWH in 1980, and 126.1 billion KWH in 1985.

The impacts of greater conservation and increased efficiency of energy-using equipment over the next ten years will, of course, be negative on electricity demand growth. The magnitude of the impacts, however, is largely a matter of guesswork. It would appear that in the case of equipment efficiency the negative effect would be quite small since it is mainly the new additions to the existing large stock that would be improved.

For the purpose of forecasting future consumption of electric power in Ontario it would be necessary to adjust the first stage projections to take account of contingencies. Such adjustments are probably more crucial for the next ten years than for the 1985-95 period, since decisions have to be made now about the need for facilities ten years hence, while decisions about need in the 1990's could be delayed without the same risks being incurred.

Treating the control projection for the 1985-1995 period as a rough approximation at this stage, one might then concentrate on adjustments for the 1975-1985 period. The procedure might be as follows:

- use the control projection as a starting point;
- adjust upward for the possibility that economic conditions might be somewhat more favourable than those assumed likely in Scenario A;
- adjust upward for the possibility of some degree of shifting to electricity by both households and industry in the event that oil and natural gas shortages are perceived as real;
- adjust downward for some minor improvements in the efficiency of electrical equipment, since such changes are likely to affect only the new stock in the next ten years;
- adjust downward to reflect the absorption of conservation practices by users over the period; and
- make no adjustment for the introduction of new alternative energy forms that have the potential of reducing electricity demand.

It seems that, if these adjustments are made, projections of demand and of need for power facilities would be based more on risk aversion than on risk acceptance, and this kind of behaviour is not indefensible in the provision of electrical power.

As an example of how the control projection for electricity demand in Ontario to 1985 might be adjusted, one might consider the following:

. Control projection average growth rate (1975-1985)	3.3%
. Allowance for higher population, employment and income as in Scenario C	+1.0%
. Allowance for some response by households to possible oil-gas shortage[1]	+0.6%

---

1. The calculations of the effect on households raised the control projection average growth rate (1975-85) from 3.3 to 4.1 per cent, a difference of 0.8 per cent. This difference is weighted by a probability of .75 on a judgmental basis to yield 0.6 per cent.

. Allowance for some response by industry to possible oil-gas shortage[1]	+1.0%
. Downward adjustment for increased efficiency in electrical equipment[2]	-0.1%
. Downward adjustment for conservation[2]	-0.2%
. Adjustment for new alternative energy forms	-0.0%
Adjusted Average Growth Rate	5.6%

On the basis of these considerations, it would appear that a forecast of growth in Ontario's consumption of electric energy over the 1975-85 period can be set in the neighbourhood of 5.5 per cent per year, in which case total annual consumption in the residential, manufacturing, mining and commercial sectors would reach a level of about 110 billion KWH in 1980, and 144 billion KWH in 1985.

A tentative projection for growth in the 1985-95 period could be the one emerging from Scenario A, which is in the order of 5 per cent per year. This, however, is a first approximation and would need to be refined as the period is approached.

Chart II shows how the projected growth rates for provincial consumption are affected by allowing for contingencies.

It is entirely valid to pose the question, "Under what circumstances might Ontario's demand for electricity continue to grow at historical rates averaging close to 7 per cent?" The conditions favouring such an outcome in the next two decades would appear to include:

- progressive decline in electricity prices relative to those of mainly oil and natural gas
- sudden reversal of the downtrend in birth rates and considerable easing of Canadian immigration policy

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1. This is a pure guess. It amounts to over 12 billion KWH in 1985, or some 15 per cent of the control projection of 82.9 billion KWH for the combined manufacturing, mining and commercial sectors.
2. These are rough guesses.

. expansion of the world economy and less rapid inflation in Canada relative to the United States, Japan and Eastern Europe so that Ontario's exportable goods and services could retain or improve their penetration

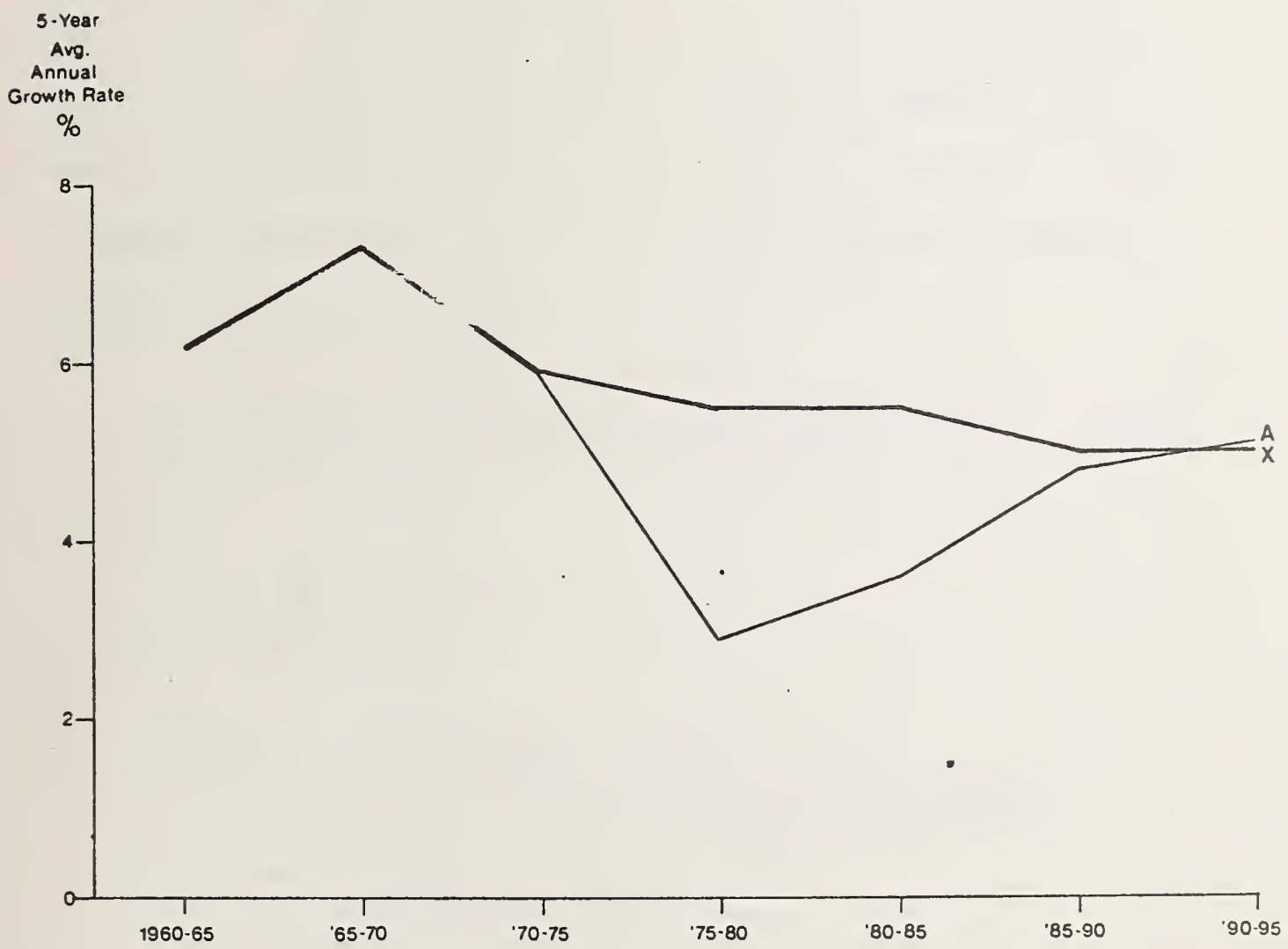
. deliberate policy by Canada to reduce oil imports even if a self-reliance strategy holds little promise

. lack of success in developing a conservation ethic with respect to energy and failure in developing or purchasing energy-efficient technology

The probability that such conditions would prevail seems, at this point in time, to be somewhat low.

GROWTH IN ONTARIO'S CONSUMPTION OF ELECTRICITY
(Projections With and Without Contingency Allowances)

CHART II



LEGEND: A - Control Projection (based on Probable Demographic, Economic and Pricing Conditions without Contingency Allowances)
X - Projection with Contingency Allowances in 1975-85 period

STATISTICAL APPENDIX

Results of Regression Analysis

Quantitative relationships between Ontario's demand for electric energy and various determinants were derived through multiple regression analysis of annual observations covering the period 1960-1972. For each of the four sectors in Ontario -- residential, manufacturing, mining and commercial services -- several equations were fitted to the data, but only those considered to be the most acceptable are reported here. The criteria for selecting the most acceptable were a combination of the standard statistical tests of goodness of fit, support for hypotheses of economic theory in terms of signs of coefficients and quantitative implications of changes in some of the main variables.

For each sector a multiplicative specification was assumed, such that:

$$Y_t = \alpha \prod_{i=0}^{k} X_{it}^{\beta_i} \; e^{u_t}$$

Where: Y is the dependent variable;
X_i is the i^{th} predetermined variable, $(i=1.....k)$
u is the error variable, normally distributed with zero mean and variance σ^2;
α and β_i are constants
t is the time subscript; and
e is the Naperian base.

Transformation into logarithms for estimation yields:

$$\log Y_t = \log \alpha + \sum_{i=0}^{k} \beta_i \log X_{it} + u_t$$

in which the coefficients β_i are to be interpreted as elasticities.

Applying ordinary least squares methods, the estimated equations reproduced in Section III of the text, and used in the projections, were as follows, with the numbers in parentheses showing the ratios of estimated coefficients to their standard errors:

a) Residential Sector

$$\log QED = \underset{(2.0)}{.7096} + \underset{(4.6)}{.7415}\log(POP*YDP) - \underset{(1.1)}{.1118}\log SD \; \underset{(3.4)}{.8367}\log CD$$

$$\bar{R}^2 = .996 \quad SEE = .01469 \quad DW = 1.31$$

b) Manufacturing Sector

$$\log QEMF = \underset{(1.1)}{2.1868} + \underset{(3.8)}{.4578}\log OMF + \underset{(2.5)}{.3859}\log QEMF_{-1} - \underset{(.61)}{.2071}\log PIQ$$

$$\bar{R}^2 = .989 \quad SEE = .0193 \quad DW = 2.27$$

c) Mining Sector

$$\log QEM = \underset{(3.7)}{5.7019} + \underset{(2.5)}{.4032}\log OM + \underset{(3.9)}{.5002}\log QEM_{-1} - \underset{(.3)}{.1579}\log SCG - \underset{(4.0)}{.9485}\log CIQ$$

$$\bar{R}^2 = .975 \quad SEE = .0394 \quad DW = 2.32$$

d) Commercial Services Sector -- Per Employee

$$\log QECE = \underset{(.2)}{.5452} + \underset{(4.9)}{2.7519}\log OCE - \underset{(3.2)}{.7995}\log CIQ$$

$$\bar{R}^2 = .981 \quad SEE = .03681 \quad DW = 1.13$$

The variables in these equations are:

QED: the quantity of electricity consumed annually in Ontario's residential sector, in billions of KWH;

POP: Ontario's population, in millions;

YDP: real annual disposable income per capita, in $ thousand (1961);

SD: ratio of the price of 1,000 KWH monthly residential consumption of electricity to the price of 1,000 cu. ft. of residential consumption of natural gas, in Ontario;

CD: ratio of the price index of appliances in the Consumer Price Index to the overall CPI;

QEMF: the quantity of electricity consumed annually in Ontario's manufacturing sector, in billions of KWH;

OMF: real value of Ontario's annual manufacturing output, in $ billion (1961);

PIQ: ratio of the price of 30,000 KWH monthly consumption of electricity to the implicit price index for delating gross national expenditure;

QEM: the quantity of electricity consumed annually in Ontario's mining sector, in billions of KWH;

OM: real value of Ontario's annual mining output, in $ billion (1961);

SCG: ratio of the price of 15,000 KWH monthly consumption of electricity to the monthly price per 100 m.c.f. of natural gas for commercial use in Ontario;

QECE: the quantity of electricity consumed annually per employee in Ontario's commercial services sector, in thousands of KWH;

OCE: real value of annual output per employee in Ontario's commercial sector, in $ thousand (1961);

CIQ: ratio of the price of 15,000 KWH monthly consumption of electricity to the implicit price index for gross national expenditure.

Data Sources for Regression Analysis

The primary data source was Statistics Canada. Some of the relevant publications are:

. Gas Utilities;
. Electric Power Statistics;
. Electricity Bills;
. Prices and Price Indexes;
. Labour Force Survey;
. National Accounts
. Canadian Statistical Review;
. Survey of Production;
. Employment Estimates.

Data on disposable income and real output by sector in Ontario were estimated by the Ministry of Treasury, Economics and Intergovernmental Affairs.

Supplementary Table

The following supplementary table relates to sectoral projections of electricity consumption in Ontario according to the scenarios discussed in Section IV of the text.

DEMAND FOR ELECTRICITY IN ONTARIO, BY SECTORS (Billions of KWH)

Table A1

	Actual*			Projected**				
	1960	1965	1970	1975	1980	1985	1990	1995
A. Control								
Residential				23.1090	28.0962	33.0766	38.6643	44.8754
Manufacturing				29.6661	33.1450	36.9060	42.2420	48.5405
Mining				4.1329	3.2987	2.7384	2.9196	3.2836
Commercial Services				27.4888	32.8702	43.3231	62.9596	91.3929
Provincial Total***				84.3968	97.4100	116.0441	146.7855	188.0924
B. Control + Lower Electricity Prices								
Residential				23.1920	28.7075	34.3767	40.8740	48.2548
Manufacturing				29.7845	34.3205	39.4959	46.7671	55.6024
Mining				4.2303	4.1678	4.3689	5.9137	8.4532
Commercial Services				27.9148	36.0468	51.3838	80.9548	127.3993
Provincial Total***				85.1216	103.2426	129.6253	174.5095	239.7097
C. Control + Higher Population, Employment, Income								
Residential	9.318	12.662	17.586	23.2236	28.9424	34.9267	41.8521	49.7974
Manufacturing	15.579	20.012	25.536	29.7562	34.0365	38.8539	45.5991	53.7274
Mining	2.286	2.004	3.263	4.1443	3.3912	2.8931	3.1699	3.6639
Commercial Services	5.742	9.900	17.043	27.7713	34.9497	47.8754	71.9814	108.6391
Provincial Total***	32.925	44.578	63.428	84.8954	101.3198	124.5492	162.6025	215.8278
D. Control + Lower Population, Employment, Income								
Residential				23.0106	27.3862	31.5598	36.1105	41.1700
Manufacturing				29.6015	32.5190	35.5672	39.9840	45.1262
Mining				4.1247	3.2337	2.6324	2.7520	3.0350
Commercial Services				27.2609	31.2682	39.7236	55.6420	76.8043
Provincial Total***				83.9977	94.4072	109.4830	134.4885	166.1354
E. Control + Higher Popn,, Emp., Income and Electricity Prices								
Residential				22.7627	25.6627	28.1929	30.7548	33.3132
Manufacturing				29.5831	32.3425	35.6757	40.4984	46.1504
Mining				4.0153	2.4690	1.6691	1.4695	1.3642
Commercial Services				27.1528	30.5320	38.7290	53.7978	75.0156
Provincial Total***				83.5139	91.0062	104.2667	126.5205	155.8434

* Statistics Canada

** Projections based on Scenarios A to E described in Section IV of the text.

*** Total Consumption in the four sectors shown. This is equivalent to Total Disposal within Ontario less allowance for losses, own use in utilities, etc.

Growth in Ontario's demand for electric energy.